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Mark Scheme (Results)

Summer 2014

Pearson Edexcel International
Advanced Level
in Physics (WPH06)
Paper 01
Experimental Physics

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Mark scheme notes

Underlying principle

The mark scheme will clearly indicate the concept that is being rewarded, backed up by examples. It is not a set of model answers.

For example:

(iii) Horizontal force of hinge on table top

66.3 (N) or 66 (N) **and** correct indication of direction [no ue] [Some examples of direction: acting from right (to left) / to the left / West / opposite direction to horizontal. May show direction by arrow. Do not accept a minus sign in front of number as direction.]	✓	**1**

This has a clear statement of the principle for awarding the mark, supported by some examples illustrating acceptable boundaries.

1. Mark scheme format

1.1 You will not see 'wtte' (words to that effect). Alternative correct wording should be credited in every answer unless the ms has specified specific words that must be present. Such words will be indicated by underlining e.g. 'resonance'

1.2 Bold lower case will be used for emphasis.

1.3 Round brackets ( ) indicate words that are not essential e.g. "(hence) distance is increased".

1.4 Square brackets [ ] indicate advice to examiners or examples e.g. [Do not accept gravity] [ecf].

2. Unit error penalties

2.1 A separate mark is not usually given for a unit but a missing or incorrect unit will normally mean that the final calculation mark will not be awarded.

2.2 Incorrect use of case e.g. 'Watt' or 'w' will **not** be penalised.

2.3 There will be no unit penalty applied in 'show that' questions or in any other question where the units to be used have been given, for example in a spreadsheet.

2.4 The same missing or incorrect unit will not be penalised more than once within one question (one clip in epen).

2.5 Occasionally, it may be decided not to penalise a missing or incorrect unit e.g. the candidate may be calculating the gradient of a graph, resulting in a unit that is not one that should be known and is complex.

2.6 The mark scheme will indicate if no unit error penalty is to be applied by means of [no ue].

3. Significant figures

3.1 Use of an inappropriate number of significant figures in the theory papers will normally only be penalised in 'show that' questions where use of too few significant figures has resulted in the candidate not demonstrating the validity of the given answer.

3.2 The use of g = 10 m s^{-2} or 10 N kg^{-1} instead of 9.81 m s^{-2} or 9.81 N kg^{-1} will be penalised by one mark (but not more than once per clip). Accept 9.8 m s^{-2} or 9.8 N kg^{-1}

5. Calculations

5.1 Bald (i.e. no working shown) correct answers score full marks unless in a 'show that' question.

5.2 If a 'show that' question is worth 2 marks then both marks will be available for a reverse working; if it is worth 3 marks then only 2 will be available.

5.3 **use** of the formula means that the candidate demonstrates substitution of physically correct values, although there may be conversion errors e.g. power of 10 error.

5.4 **recall** of the correct formula will be awarded when the formula is seen or implied by substitution.

5.5 The mark scheme will show a correctly worked answer for illustration only.

5.6 Example of mark scheme for a calculation:

'Show that' calculation of weight

Use of L × W × H	✓	
Substitution into density equation with a volume and density	✓	
Correct answer [49.4 (N)] to at least 3 sig fig. [No ue] [If 5040 g rounded to 5000 g or 5 kg, do not give 3rd mark; if conversion to kg is omitted and then answer fudged, do not give 3rd mark] [Bald answer scores 0, reverse calculation 2/3]	✓	**3**

Example of answer:

80 cm × 50 cm × 1.8 cm = 7200 cm^3

7200 cm^3 × 0.70 g cm^{-3} = 5040 g

5040 × 10^{-3} kg × 9.81 N/kg

= 49.4 N

6. Quality of Written Communication

6.1 Indicated by QoWC in mark scheme. QWC – Work must be clear and organised in a logical manner using technical wording where appropriate.

6.2 Usually it is part of a max mark, the final mark not being awarded unless the QoWC condition has been satisfied.

7. Graphs

7.1 A mark given for axes requires both axes to be labelled with quantities and units, and drawn the correct way round.

7.2 Sometimes a separate mark will be given for units or for each axis if the units are complex. This will be indicated on the mark scheme.

7.3 A mark given for choosing a scale requires that the chosen scale allows all points to be plotted, spreads plotted points over more than half of each axis and is not an awkward scale e.g. multiples of 3, 7 etc.

7.4 Points should be plotted to within 1 mm.

- Check the two points furthest from the best line. If both OK award mark.
- If either is 2 mm out do not award mark.
- If both are 1 mm out do not award mark.
- If either is 1 mm out then check another two and award mark if both of these OK, otherwise no mark.

For a line mark there must be a thin continuous line which is the best-fit line for the candidate's results.

Question Number	Answer	Mark
1(a)(i)	Precision of 0.01 mm is much less than diameter of wire. **Or** Precision of 0.01 mm will give small %U (1) Allow precision is to 0.001 mm	**1**
1(a)(ii)	Check zero error **Or** avoid squashing wire (1) Accept Take multiple readings and find mean **or** different places and find mean **or** different orientations and find mean	**1**
1(b)(i)	Use of $\rho = R \times A/l$ (1) $\rho = 5.73 \times 10^{-7}$ (Ωm) to 3 SF (1) [be aware of interim calculation e.g. 5.74 if area calculated] Example of calculation $\rho = R \times A/l$ $\rho = 15.68\ \Omega \times \pi \times (2.04\times10^{-4})^2\ m^2 / 4 \times 0.894$ m $\rho = 5.73 \times 10^{-7}\ \Omega$m	**2**
1(b)(ii)	Adds their %U in R and d (2%) (1) Doubles %U in d (no SF penalty) (1) %U in range 3.3 – 3.5 (1) Example of calculation $\Delta\rho/\rho = \Delta R/R + \Delta A/A = \Delta R/R + 2\Delta d/d$ $\Delta\rho/\rho = \{(0.07/15.68) + 2\times(0.003/0.204)\}\times 100$ $= 0.45 + 2\times1.5 = 3.5\%$ $0.4464 + 2\times 1.471 = 3.388\%$	**3**
	Total for question 1	**7**

Question Number	Answer		Mark
2(a)	Rule shown vertical (stated or shown in diagram) Use of set square to bottom/top of ball **Or** states that metre ruler must touch ball and goes on to use tangent method Makes second reading and halves the difference **Or** takes metre rule reading at the point of contact.	(1) (1) (1)	**3**
2(b)	Measure at least 10T Repeat and average Use timing marker in centre of swing **Or** allow swings to settle before timing **Or** use small angle of swing	(1) (1) (1)	**3**
2(c)(i)	Gradient is given by $-4\pi^2/g$	(1)	**1**
2(c)(ii)	Intercept given by $\frac{4\pi^2 H}{g}$ Derivation shown correctly Example of answer $\frac{4\pi^2 H}{g} \times \frac{g}{4\pi^2} = H$ [accept division with some further explanation], [ignore minus sign here]	(1) (1)	**2**
	Total for question 2		**9**

<table>
<tr><th>Question Number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>3(a)(i)</td><td>Use of $k = V\lambda^2$ ignore powers of ten (1)
Repeats and determines mean (1)
$k = 1.20 \times 10^{-18}$ m^{2}V with unit and 3 SF [beware powers of ten] (1)

<u>Example of calculation</u>

<table>
<tr><th>V/kV</th><th>$\lambda/10^{-12}$ m</th><th>$k = V\lambda^2/ 10^{-18}$ m^2 V</th></tr>
<tr><td>200</td><td>2.51</td><td>1.26</td></tr>
<tr><td>300</td><td>1.95</td><td>1.14</td></tr>
</table>

Mean $k = 1.20 \times 10^{-18}$ m^2 V</td><td>3</td></tr>
<tr><td>3(a)(ii)</td><td>Uses half range, or range, for %U = 5% (range gives 10%) (1)
(ecf their values from (i))

<u>Example of calculation</u>
Half range is $(0.12\times 10^{-18})/2 = 0.06 \times 10^{-18}$
%U = (0.06/1.20) × 100 = 5% [range gives 10%]</td><td>1</td></tr>
<tr><td>3(b)(i)</td><td>Use of $h = \sqrt{2emk}$ (1)
$h = 5.91 \times 10^{-34}$ Js - to at least 2 SF (1)
(ecf their value for (a)(i))

<u>Example of calculation</u>
$h = \sqrt{2emk} = (2\times1.6\times10^{-19}\times9.11\times10^{-31}\times1.20\times10^{-18})^{½}$

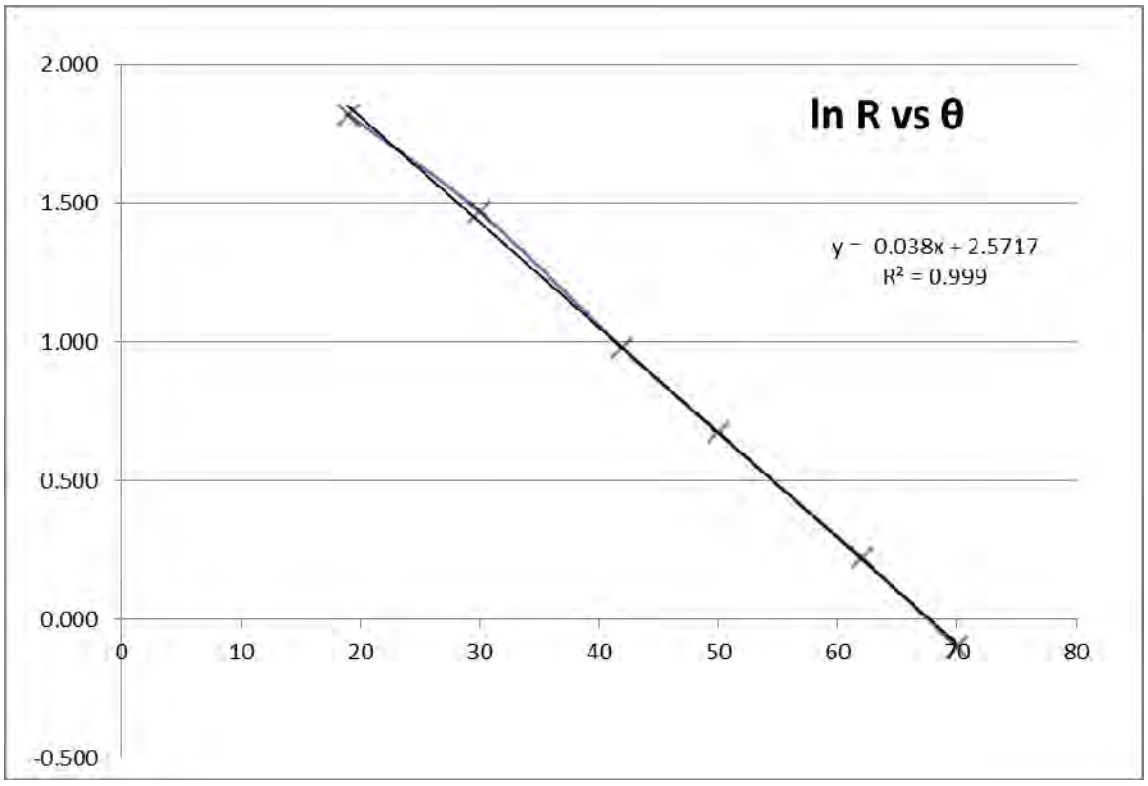
$h = 5.91\times10^{-34}$ Js</td><td>2</td></tr>
<tr><td>3(b)(ii)</td><td>Half their value in (a) (ii) (1)</td><td>1</td></tr>
<tr><td>3(b)(iii)</td><td>Finds %D using 6.63×10^{-34} Js as denominator
Or calculates upper/lower limit from %U (1)

Comment consistent with their answer
Or Not enough data for a valid conclusion (1)

<u>Example of calculation</u>
For %D $\Delta h/ h = (6.63 – 5.91)/6.63 = 10.9\%$
%D > %U so result does not support theory ignore reference to 10%</td><td>2</td></tr>
<tr><td></td><td>Total for question 3</td><td>9</td></tr>
</table>

Question Number	Answer		Mark
4(a)	An increase in the number of conduction electrons Linked to the increase in energy of these electrons	(1) (1)	**2**
(b)(i)	*Apparatus* - **Max 2** Thermometer Ohmmeter **or** ammeter and voltmeter (Must have circuit diagram for V & A with psu) heat source (can be awarded in diagram or list)	(1) (1) (1)	**2**
(b)(ii)	*Method* use ice(to get to 0 °C) **and** heat(to get to 100 °C)	(1)	**1**
(b)(iii)	*Precaution* - **Max 2** Anything appropriate such as removing heat source when reading stirring Keep thermometer close to thermistor **Or** Keep thermometer away from sides/bottom Do not allow repeat readings	(1) (1) (1)	**2**
4 (c)(i)	$\ln R = - \alpha\theta + \ln R_0$ (comparison with y = mx + c must be clear but need not be direct)	(1)	**1**
4 (c)(ii)	Table values For R in kΩ correct to at least 3 decimal places and ignore bottom value **Or** For R in Ω all correct to at least 3 SF Axes & labels Scales Plots & line	(1) (1) (1) (1)	**4**
4 (c)(iii)	Large triangle (at least half the plotted length), measurements correct Gradient calculation in range $0.0365 \leq a \leq 0.0395$ Value for α is positive value of their gradient with 3 SF and unit	(1) (1) (1)	**3**
	Total for question 4		**15**

θ /°C	R/kΩ	ln(R/kΩ)	ln(R/Ω)
19	6.17	1.820	8.727
30	4.35	1.470	8.378
42	2.66	0.978	7.886
50	1.96	0.673	7.581
62	1.25	0.223	7.131
70	0.906	-0.099	6.809



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